# METHOD AND APPARATUS FOR SIGNALING SEQUENCE ROOT

## CROSS REFERENCE TO RELATED APPLICATIONS

[0001]    This is a Divisional application of U.S. patent application Ser. No. 13/464,213, filed on May 4, 2012, the disclosure of which is incorporated herewith in its entirety.

## TECHNICAL FIELD

[0002]    This invention relates generally to wireless communications, and more specifically is directed toward signaling for avoiding conflict in messages from different user devices.

## BACKGROUND

[0003]    Wireless communication systems are now very widely deployed and in recent years have been adapted to handle greater volumes and varieties of data. This has led to the available radio spectrum becoming scarce. To improve efficiency or data throughput in wireless systems, the volume of control data has been reduced to leave more spectrum available for user/substantive data. One competing design criteria to maximize throughput is to assure there is no ambiguity when data is transmitted the first time, to avoid the need to re-transmit the same data again. In some radio access technologies an acknowledgement ACK that a radio device has correctly received some particular data block are distinguishable in the time domain from other devices' similar ACKs, for example if the timeslot for sending an ACK is tightly mapped to the timeslot in which the corresponding data block was sent. This mapping saves on control overhead because the ACK itself does not need to be increased in size to explicitly identify the particular device that sent it. But ACKs are not only for data so this time domain distinction may not always be available.

[0004]    In other ACK signaling techniques the ACKs from multiple devices are sent in parallel in a same frequency band. The receiver of those parallel ACKs still needs to distinguish them from one another so it can know which device if any failed to properly receive the information being ACK'd. Time domain mapping as in the above example is no longer possible with parallel ACKs, and frequency domain mapping is not available when the parallel ACKs are in the same channel. User radio devices such as mobile terminals in a cell are assigned temporary identifiers (IDs) which are much shorter than the globally-unique universal subscriber identity and are also intended to be unique in at least the cell. But even temporary cell IDs are a bit large to append to every ACK signaling instance, since the ACK information itself may be as small as two or even one bit.

[0005]    When considering the licensed radio spectrum, adjacent cells may coordinate with one another to assure both cells do not use a same temporary ID for different users, else one cell might receive signaling from a user within the adjacent cell but near the cell edge and mistakenly conclude it originated from a user in its own cell. This coordination is not always available for radio operations in the unlicensed band, where one ad hoc network might not be aware of all the other nearby local networks. What is needed is a spectrum efficient way to distinguish parallel signaling so the receiving party can know exactly which devices sent it and which did not. Preferably this spectrum efficient way would be valid for both licensed and unlicensed radio spectrum.

## SUMMARY

[0006]    According to a first exemplary aspect the invention there is a method comprising: utilizing at a first access node of a first network code sequences assigned to different user devices to distinguish at least acknowledgements from the user devices that are received in parallel or sequentially; determining from signaling received at the first access node of the first network that a root sequence of the code sequences is in use by a second access node of a second network; and thereafter changing the root sequence of the code sequences assigned to the different user devices.

[0007]    According to a second exemplary aspect the invention there is an apparatus comprising: at least one processor and at least one memory including computer program code. In this aspect the at least one memory and the computer program code are configured, with the at least one processor and in response to execution of the computer program code, to cause the apparatus to perform at least: utilizing at a first access node of a first network code sequences assigned to different user devices to distinguish at least acknowledgements from the user devices that are received in parallel or sequentially; determining from signaling received at the first access node of the first network that a root sequence of the code sequences is in use by a second access node of a second network; and thereafter changing the root sequence of the code sequences assigned to the different user devices.

[0008]    According to a third exemplary aspect the invention there is a computer readable memory storing a program of instructions which when executed by at least one processor result in actions comprising: utilizing at a first access node of a first network code sequences assigned to different user devices to distinguish at least acknowledgements from the user devices that are received in parallel or sequentially; determining from signaling received at the first access node of the first network that a root sequence of the code sequences is in use by a second access node of a second network; and thereafter changing the root sequence of the code sequences assigned to the different user devices.

[0009]    According to a fourth exemplary aspect the invention there is a method comprising: utilizing a code sequence to distinguish at least an acknowledgement, sent from a first user device to a first access node of a first network, from at least other acknowledgements that may be sent by other user devices in parallel or sequentially; from signaling received at the first user device, determining a root sequence in use by a second access node of a second network; and thereafter compiling an uplink message for informing the first access node of the root sequence in use by the second access node.

[0010]    According to a fifth exemplary aspect the invention there is an apparatus comprising: at least one processor and at least one memory including computer program code. In this aspect the at least one memory and the computer program code are configured, with the at least one processor and in response to execution of the computer program code, to cause the apparatus to perform at least: utilizing a code sequence to distinguish at least an acknowledgement, sent from a first user device to a first access node of a first network, from at least other acknowledgements that may be sent by other user devices in parallel or sequentially; from signaling received at the first user device, determining a root sequence in use by a second access node of a second network; and thereafter compiling an uplink message for informing the first access node of the root sequence in use by the second access node.